INTRODUCTION TO EARNED VALUE MANAGEMENT

INSTRUCTOR

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AGENDA

- Introduction to Earned Value
- What Kind of Questions Can Earned Value Answer?

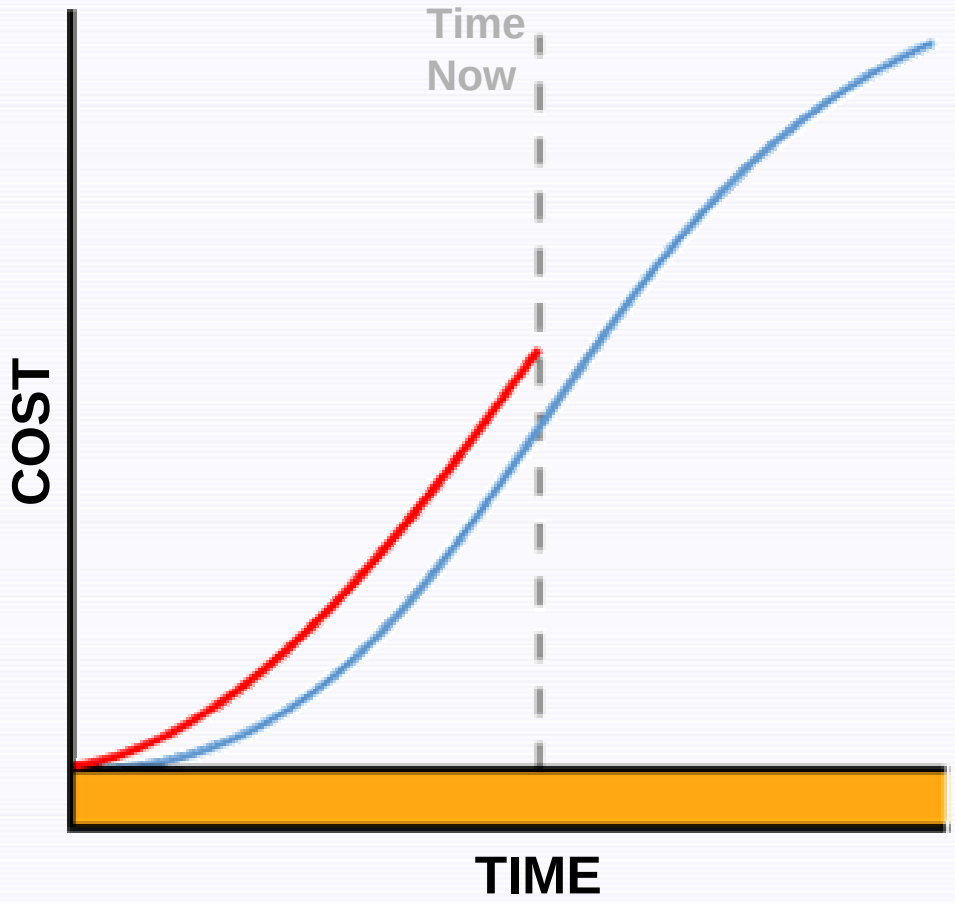
INTRODUCTION TO EARNED VALUE

WELCOM

EARNED VALUE AND EVMS

- **Earned value (EV)** is a means of placing a dollar value on project status.
- **Earned Value Management System (EVMS)** is a set of best business practices, processes, and tools for enterprise planning and control. The process includes integration of scope, schedule, cost, a PMB, and earned value.

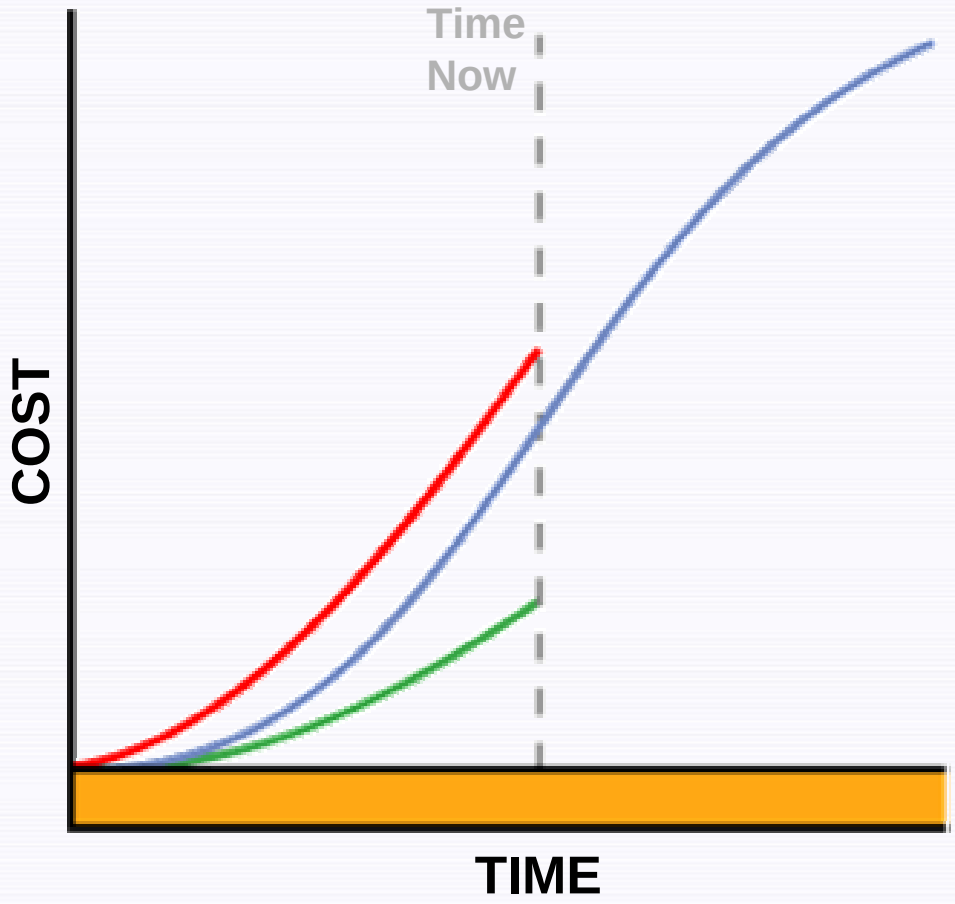
HOW IS THIS PROJECT DOING?



Planned Value (PV)

Actual Costs (AC)

HOW IS IT DOING NOW?



Planned Value (PV)

Actual Costs (AC)

Earned Value (EV)

ACRONYMS

PV —— Planned Value or budget

AC —— Actual Costs

EV —— Earned Value

ETC —— Estimate To Complete

EAC —— Estimate At Complete

BAC —— Budget At Complete

PMB —— Performance Measurement Baseline

ACRONYMS

CV —— Cost Variance

SV —— Schedule Variance

VAR —— Variance At Complete

CPI —— Cost Performance Index

SPI —— Schedule Performance Index

TCPI —— To Complete Performance Index

HOW EV IS CALCULATED

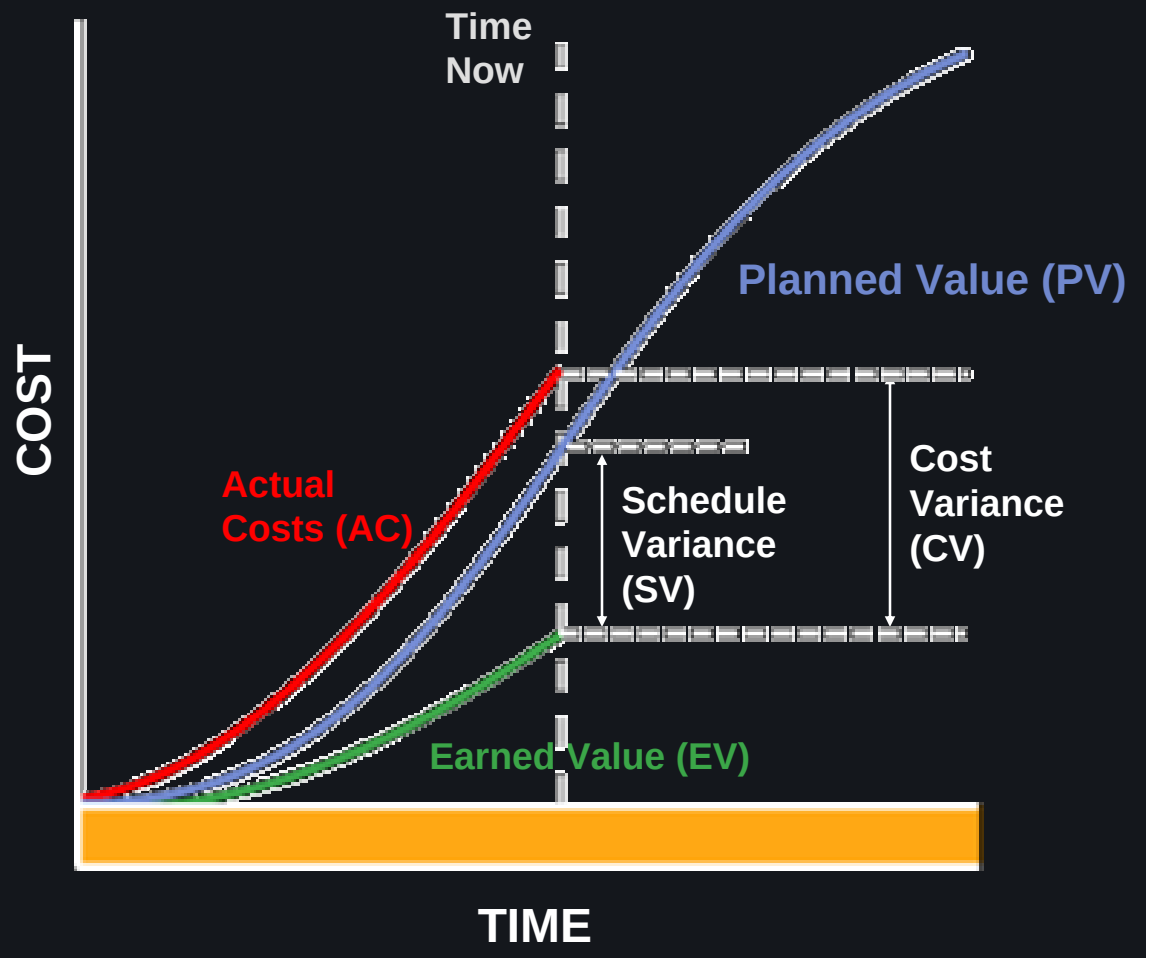
- For completed tasks:
  EV = PV (or budget)
- For tasks not yet started:
  EV = 0
- For tasks in-progress:
  EV = PV x percent complete †
- For level-of-effort tasks:
  EV = PV

† EVMS uses objective methodologies

COST AND SCHEDULE VARIANCE

CV = EV – AC

SV = EV – PV



COST PERFORMANCE INDEX

A **cost efficiency** factor representing the relationship between the **actual costs expended** and the **value of the physical work performed** (earned value).

CPI = EV / AC

A CPI of .85 means that for every dollar spent, only 85¢ worth of work gets completed.

SCHEDULE PERFORMANCE INDEX

A **schedule efficiency** factor representing the relationship between the **value of the initial planned work** and the **value of the physical work performed** (earned value).

SPI = EV / PV

A SPI of .85 means that for every dollar of budget, only 85¢ worth of work gets completed.

MANAGEMENT BY EXCEPTION

Instead of managing everything, look for items that are not performing as planned.

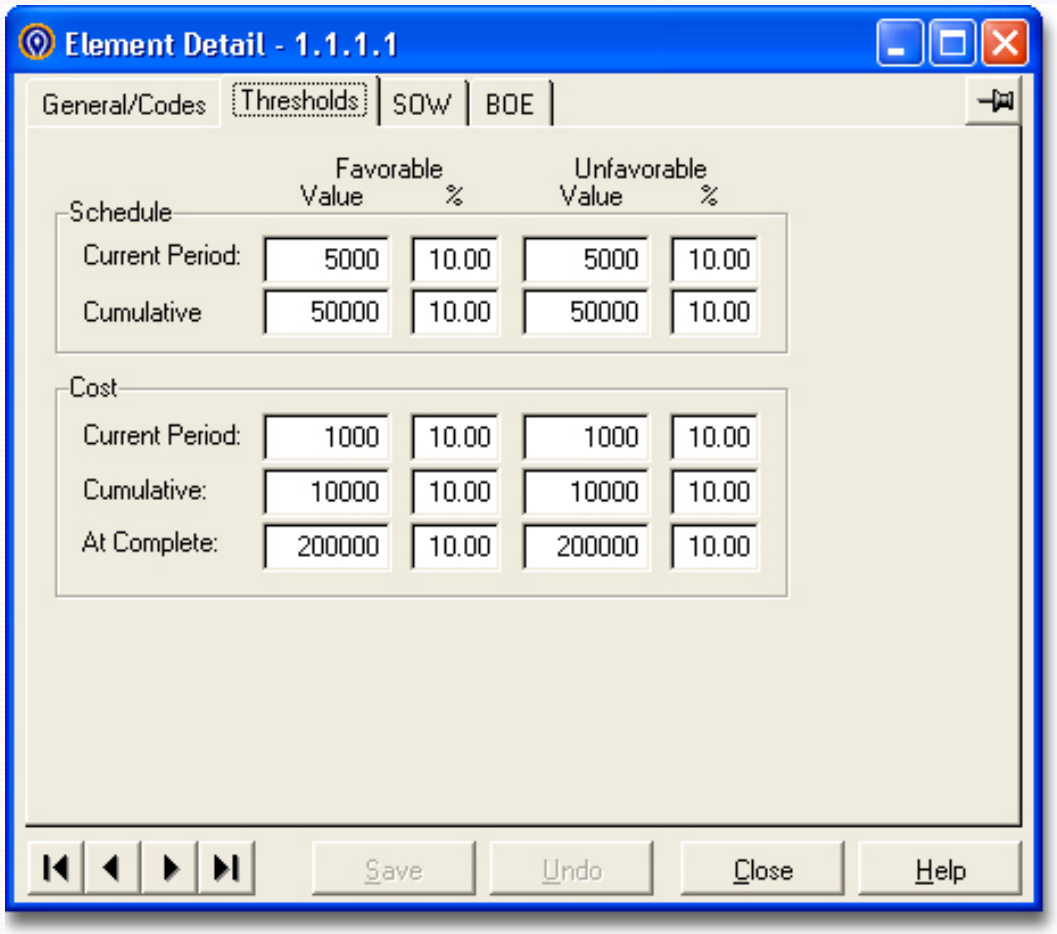
- Efficient means of managing lots of projects/activities
- Based on pre-defined thresholds for cost and schedule variances
- Yields an early warning signal for corrective action

MANAGEMENT BY EXCEPTION

Drill Down Analysis: DEMOADV Breakdown Structure DEMOWBS

	Code	Description	Start Date	Finish Date	CV	SV	BCWS	ACWP	BCWP	BAC	SPI	CPI	EAC	VAC
-	1	Space Shuttle	06/30/2001	06/30/2004	17,439	24,925	132,947	140,433	157,872	2,269,864	1.18	1.12	2,248,517	21,347
-	1.1	Design	06/30/2001	04/15/2002	-9,004	5,259	117,694	131,958	122,954	184,675	1.04	0.93	190,508	-5,833
-	1.1.1	Exterior	06/30/2001	01/15/2002	-17,140	-3,177	115,981	129,943	112,803	121,058	0.97	0.86	137,200	-16,141
	1.1.1.1	Structural	06/30/2001	10/31/2001	-8,824	0	75,862	84,686	75,862	75,862	1.00	0.89	84,686	-8,824
	1.1.1.2	Propulsion	06/30/2001	01/15/2002	-8,315	-3,177	40,119	45,257	36,941	45,196	0.92	0.81	52,513	-7,317
-	1.1.2	Interior	09/30/2001	04/15/2002	8,135	8,437	1,712	2,014	10,150	63,616	5.92	5.03	53,308	10,308
	1.1.2.1	Ergonomics	09/30/2001	04/15/2002	8,135	8,437	1,712	2,014	10,150	57,855	5.92	5.03	48,968	8,886
	1.1.2.2	Experiments	12/31/2001	04/15/2002	0	0	0	0	0	5,761	0.00	0.00	4,339	1,421
+	1.2	Flight Preparations	09/30/2001	04/01/2003	9,942	1,383	10,168	1,609	11,552	484,952	1.13	7.17	474,468	10,483
+	1.2.1	Flight Course	09/30/2001	03/01/2003	9,942	1,383	10,168	1,609	11,552	261,522	1.13	7.17	251,361	10,161
	1.2.3	Emergency Rescue	03/31/2002	04/01/2003	0	0	0	0	0	223,429	0.00	0.00	223,107	322
+	1.3	Software	09/30/2001	07/15/2003	16,501	18,281	5,084	6,865	23,366	247,162	4.59	3.40	229,693	17,468
	1.4	Systems Checks	05/31/2003	06/30/2004	0	0	0	0	0	45,339	0.00	0.00	45,339	0
	1.5	Prepare Astronauts	/ /	/ /	0	0	0	0	0	0	0.00	0.00	0	0
	1.6	Launch Preparations	03/31/2003	06/30/2004	0	0	0	0	0	1,307,734	0.00	0.00	1,308,505	-770

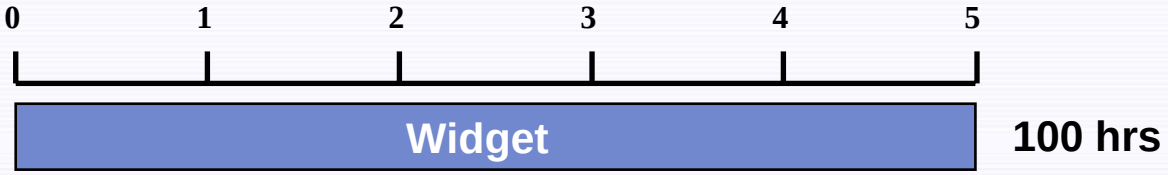
MANAGEMENT BY EXCEPTION



SIMPLE EXAMPLE

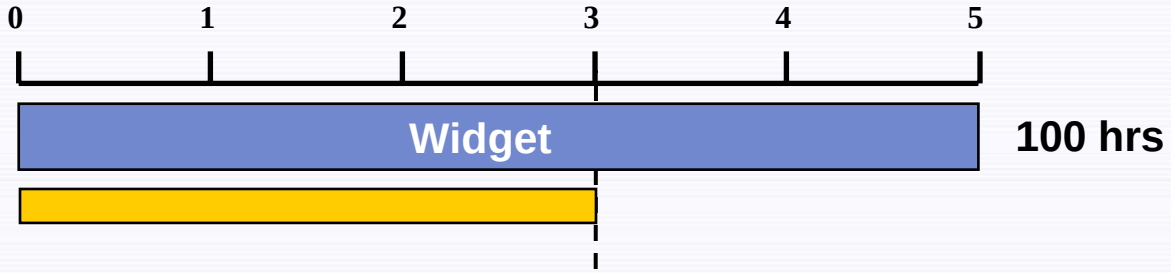
- Project
  - Build ‘Widget’ over 5 week period
  - Budget 100 hours for the project
  - Set Planned Value = $5,000 ($50/hour)

PROJECT PLAN



	1	2	3	4	5
Hrs	20	40	60	80	100
PV	$1,000	$2,000	$3,000	$4,000	$5,000

PROJECT STATUS – WEEK 3



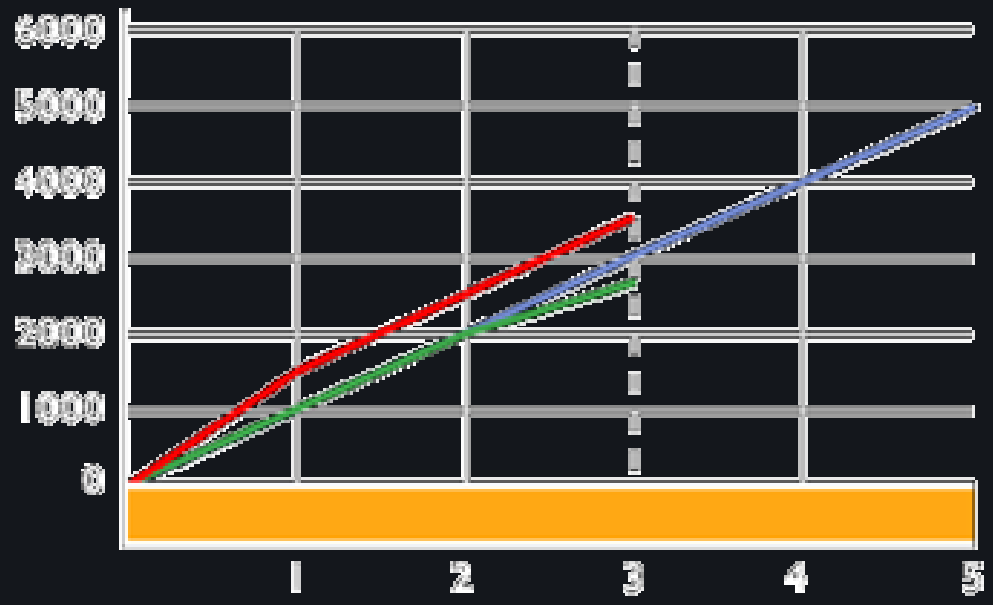
	1	2	3	4	5
Hrs	20	40	60	80	100
PV	$1,000	$2,000	$3,000	$4,000	$5,000
AC	$1,500	$2,500	*$3,500*		
EV	$1,000	$2,000	*$2,700*		

EARNED VALUE - WEEK 3

Planned Value = $3,000

Actual Cost = $3,500

Earned Value = $2,700



VARIANCE INDICATORS

- Cost Variance (CV)

  = Earned Value – Actual Cost

  = $2,700 – $3,500 = ($800)

  Negative value is bad
  Positive value is good

VARIANCE INDICATORS

- Schedule Variance (SV)

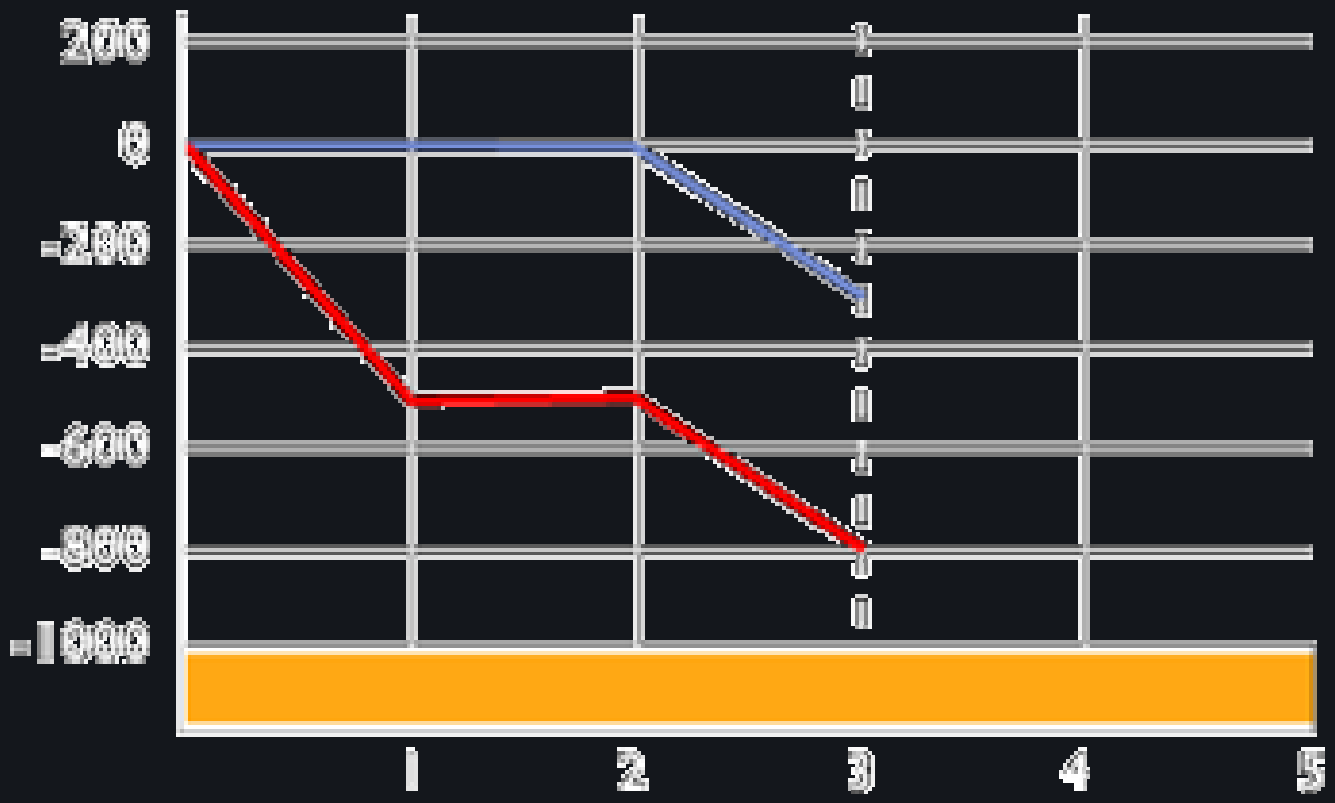
  = Earned Value – Planned Value

  = $2,700 – $3,000 = ($300)

  Negative value is bad †
  Positive value is good †

† In conjunction with critical path analysis

VARIANCE INDICATORS



Schedule Variance (SV)

Cost Variance (CV)

PERCENTAGE VARIANCES

- Cost Variance %

$$= \frac{CV \times 100}{\text{Earned Value}}$$

= ($800) x 100 / $2,700 = (29.63%)

- Schedule Variance %

$$= \frac{SV \times 100}{\text{Planned Value}}$$

= ($300) x 100 / $3,000 = (10%)

PERFORMANCE INDICATORS

- Cost Performance Index (CPI)

  = Earned Value

  Actual Cost

  = $2,700 / $3,500 = 0.77

  CPI = 1 – spending as planned

  CPI < 1 – overspending

  CPI > 1 – underspending

PERFORMANCE INDICATORS

- Schedule Performance Index (SPI)

  = Earned Value

  Planned Value

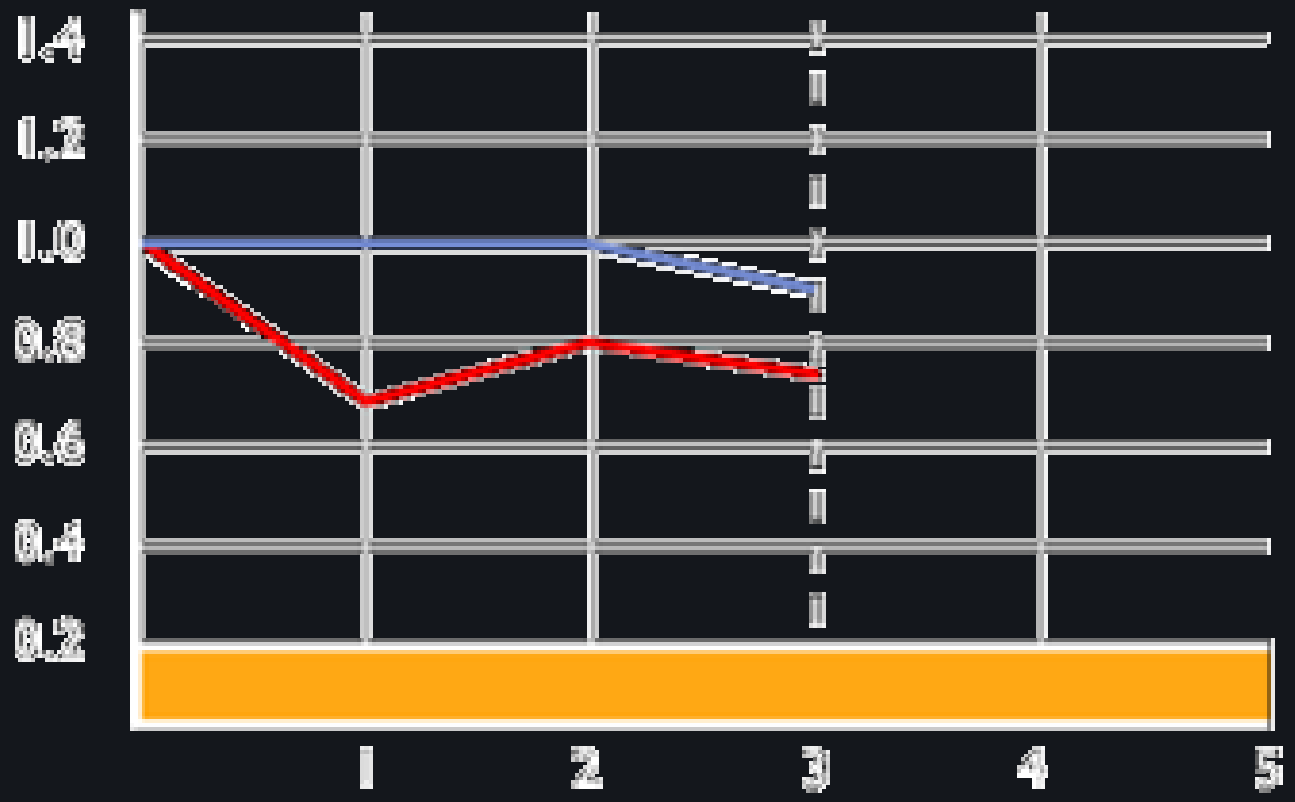
  = $2,700 / $3,000 = 0.9

  SPI = 1 – earning as planned

  SPI < 1 – earning less than planned

  SPI > 1 – earning more than planned

PERFORMANCE INDICATORS



Schedule Performance Index (SPI)

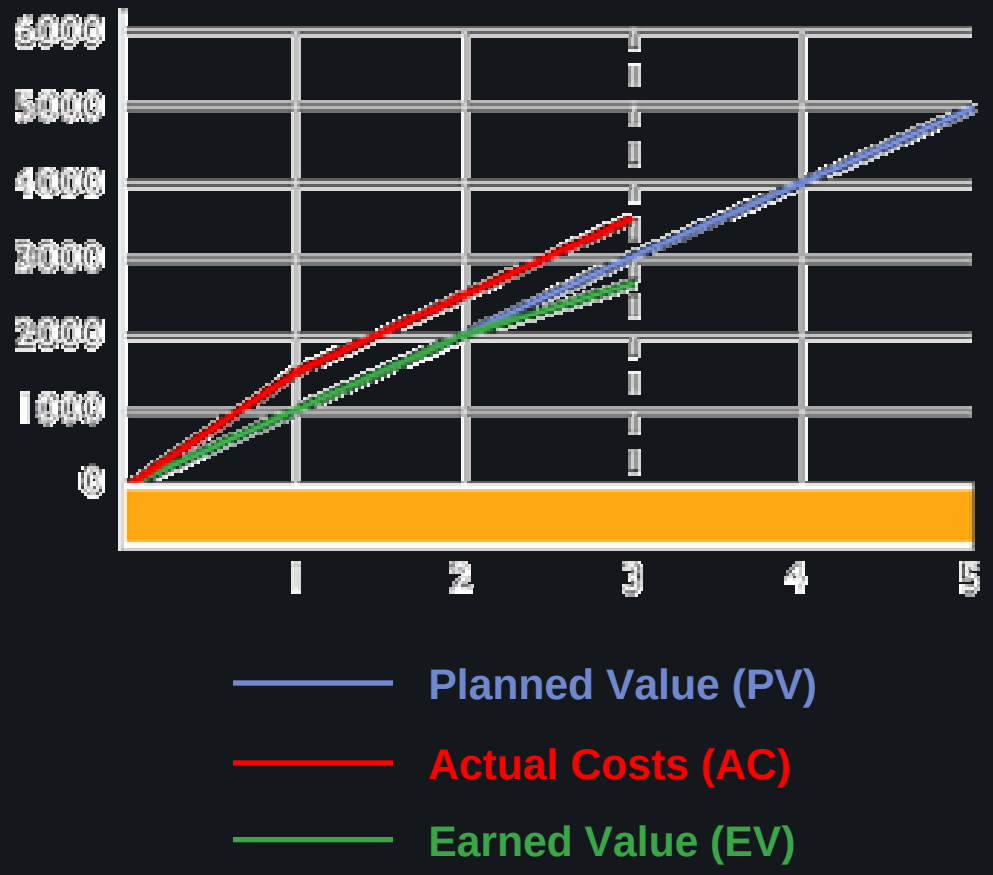
Cost Performance Index (CPI)

EXAMPLE - SUMMARY

End of Week 3:

CV = ($800)
CV% = (29.6%)
CPI = 0.77

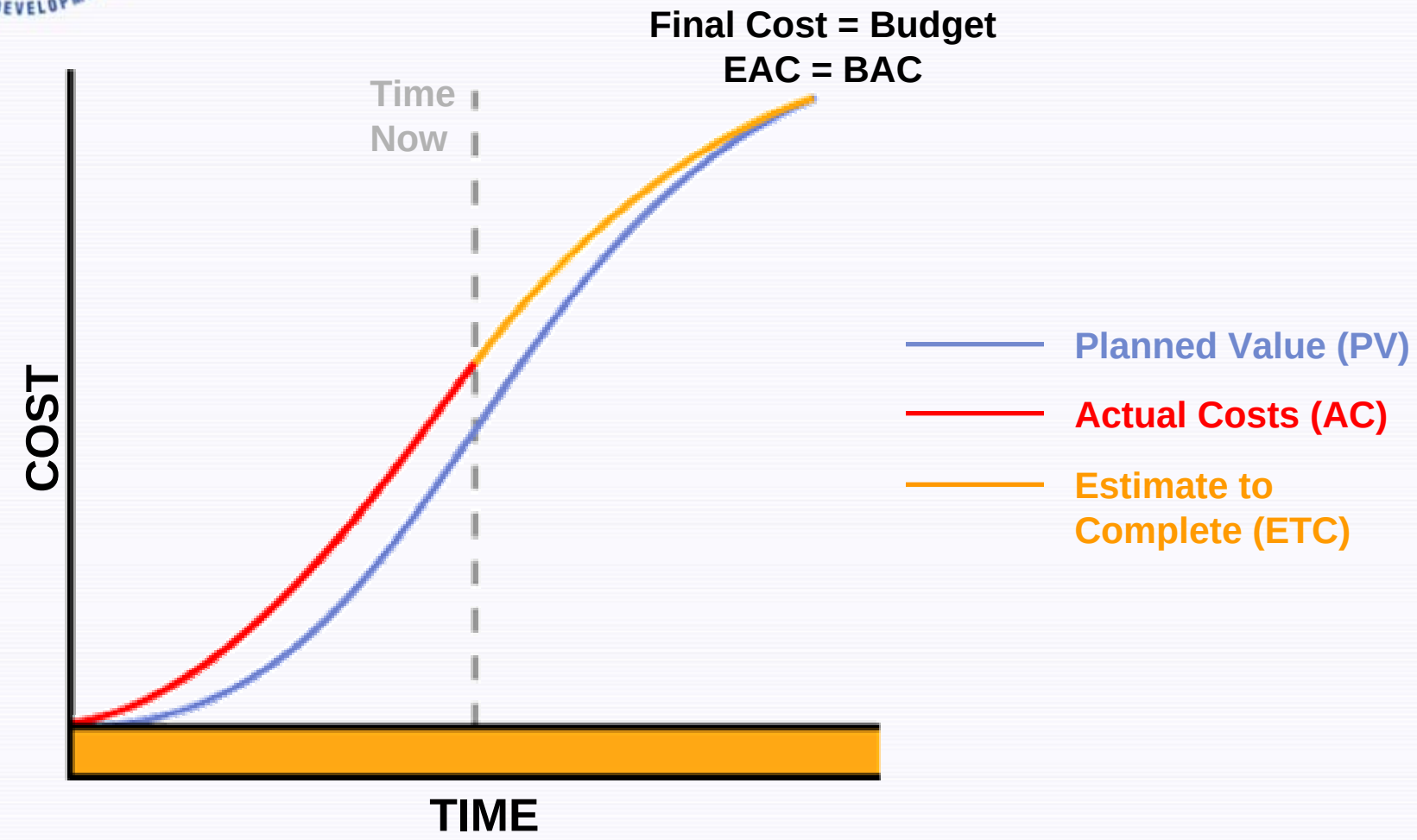
SV ($300)
SV% = (10%)
SPI = 0.9



WHAT KIND OF QUESTIONS CAN EARNED VALUE ANSWER?


My project is half way completed and my actual costs are higher than budgeted. What will it cost to complete the project?

EAC = BAC IS THIS REALISTIC?

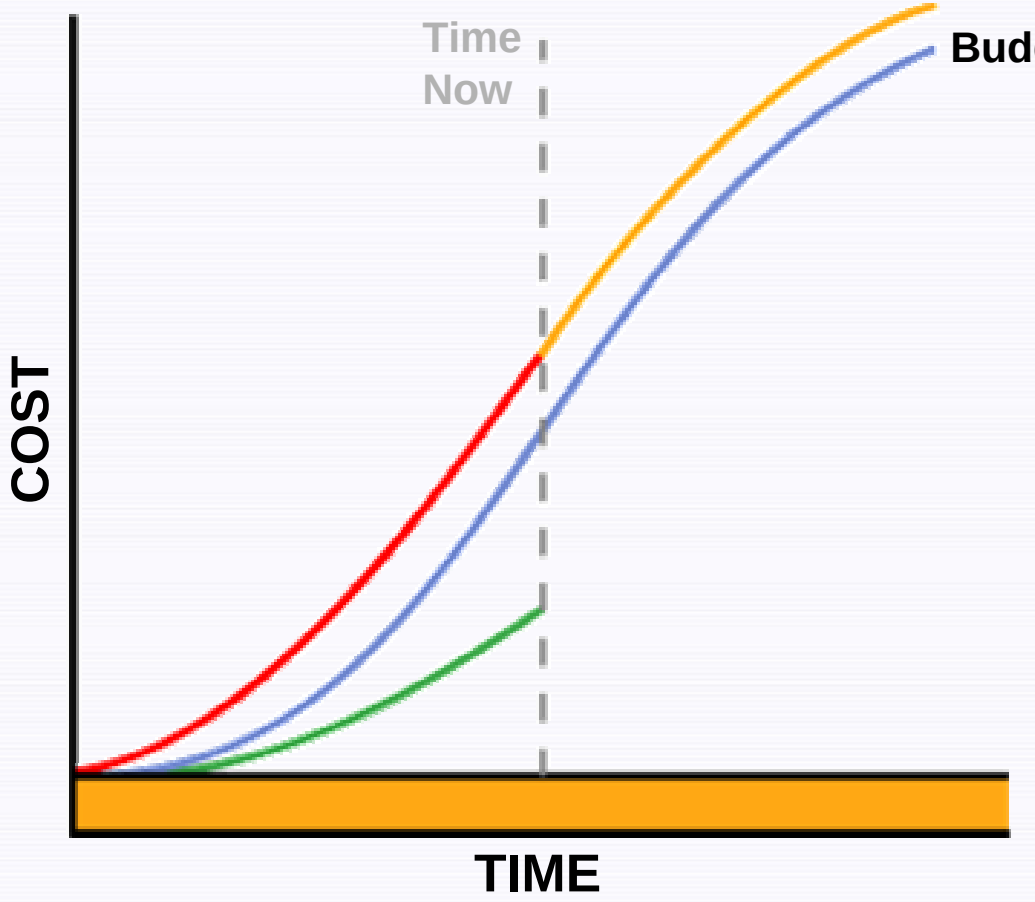


EAC = BAC

A Study of 400 projects revealed that project performance does not tend to improve once the project has surpassed the 15% completion point.
It often gets even worse!

Beach, Chester Paul Jr. "A-12 Administrative Inquiry."
Report to the Secretary of the Navy.
Department of the Navy, Washington DC.

IS THIS MORE REALISTIC?



Estimate At Complete (EAC)

Budget At Complete (BAC)

Planned Value (PV)

Actual Costs (AC)

Earned Value (EV)

Estimate to Complete (ETC)

SO WHAT *WILL* IT COST?

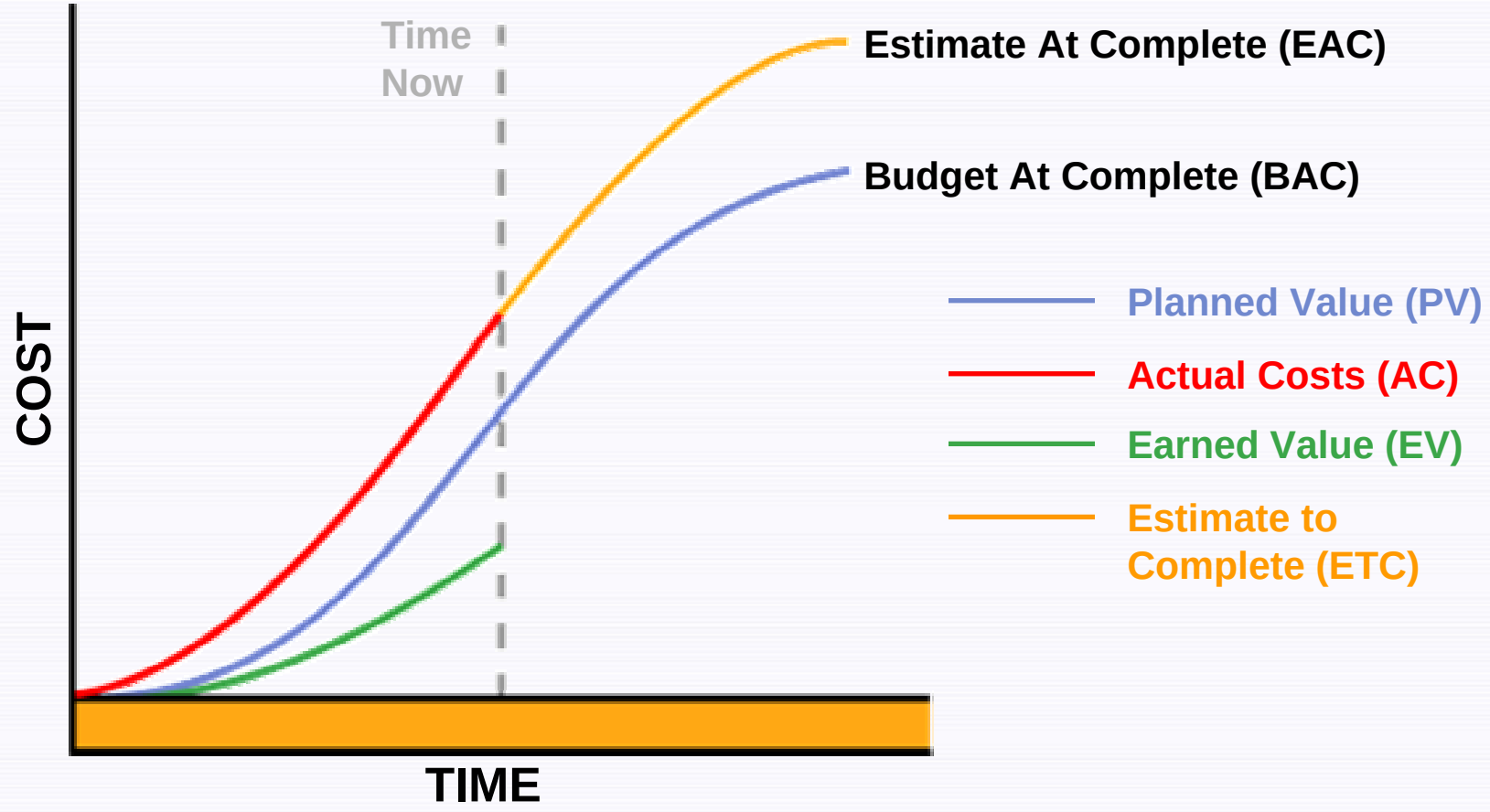
- Using the remaining budget
  - Misleading because it implies improved performance
- Re-evaluating the remaining work
  - More accurate but very labor-intensive
- Making statistical forecasts

STATISTICAL FORECASTS

Results show that the average EAC based on the cumulative CPI was the [best case scenario] to the average cost at completion. Other common index-based EACs that are found to be higher are more accurate. In particular, studies show EACs based on the schedule performance index (SPI) tend to be significantly higher and are generally more accurate.

Christensen, David S., Ph.D., "Project Advocacy and the Estimate at Completion Problem". Journal of Cost Analysis.

STATISTICAL FORECASTS



STATISTICAL FORECASTS

The remaining budget is multiplied by 1/CPI.

$$ETC = 1/CPI \times (BAC - EV)$$

The ETC is then added to the Actual Costs to get an EAC.

$$EAC = ETC + AC$$

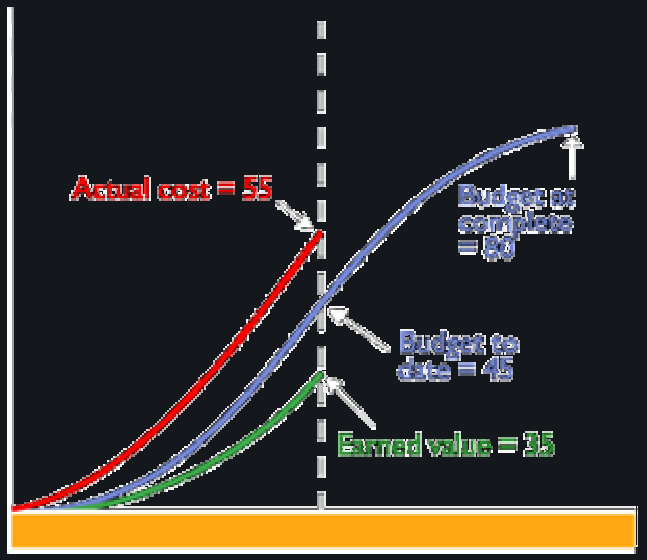
EXAMPLE

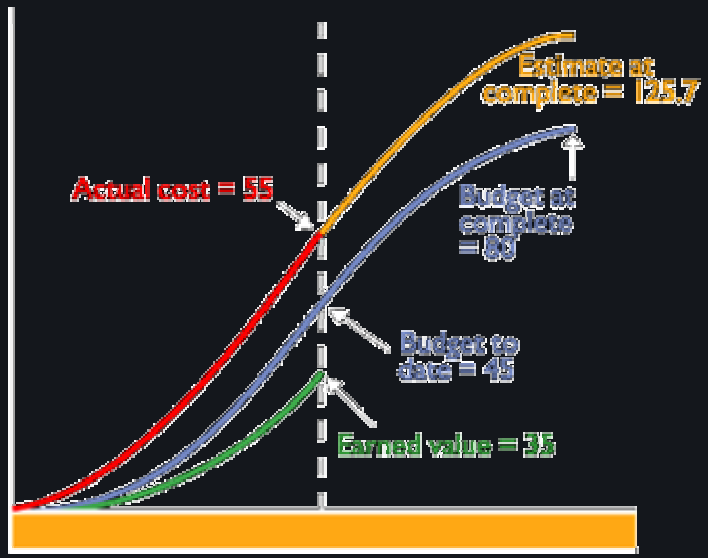
ETC = 1/CPI x (BAC - EV)

BAC – EV = 80 - 35 = 45

CPI = EV/AC = 35/55 = 0.636

ETC = 1/0.636 x 45 = $70.7





EAC = ETC + AC

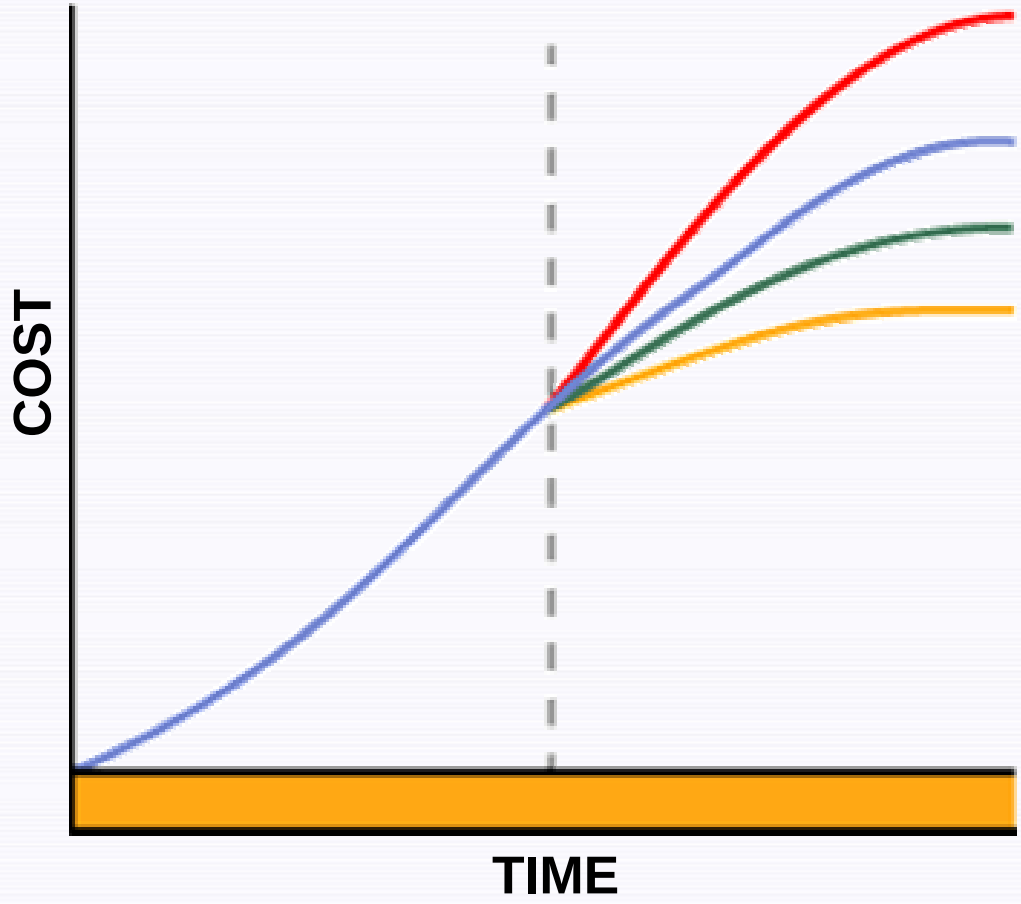
EAC = 70.7 + 55

EAC = $125.7

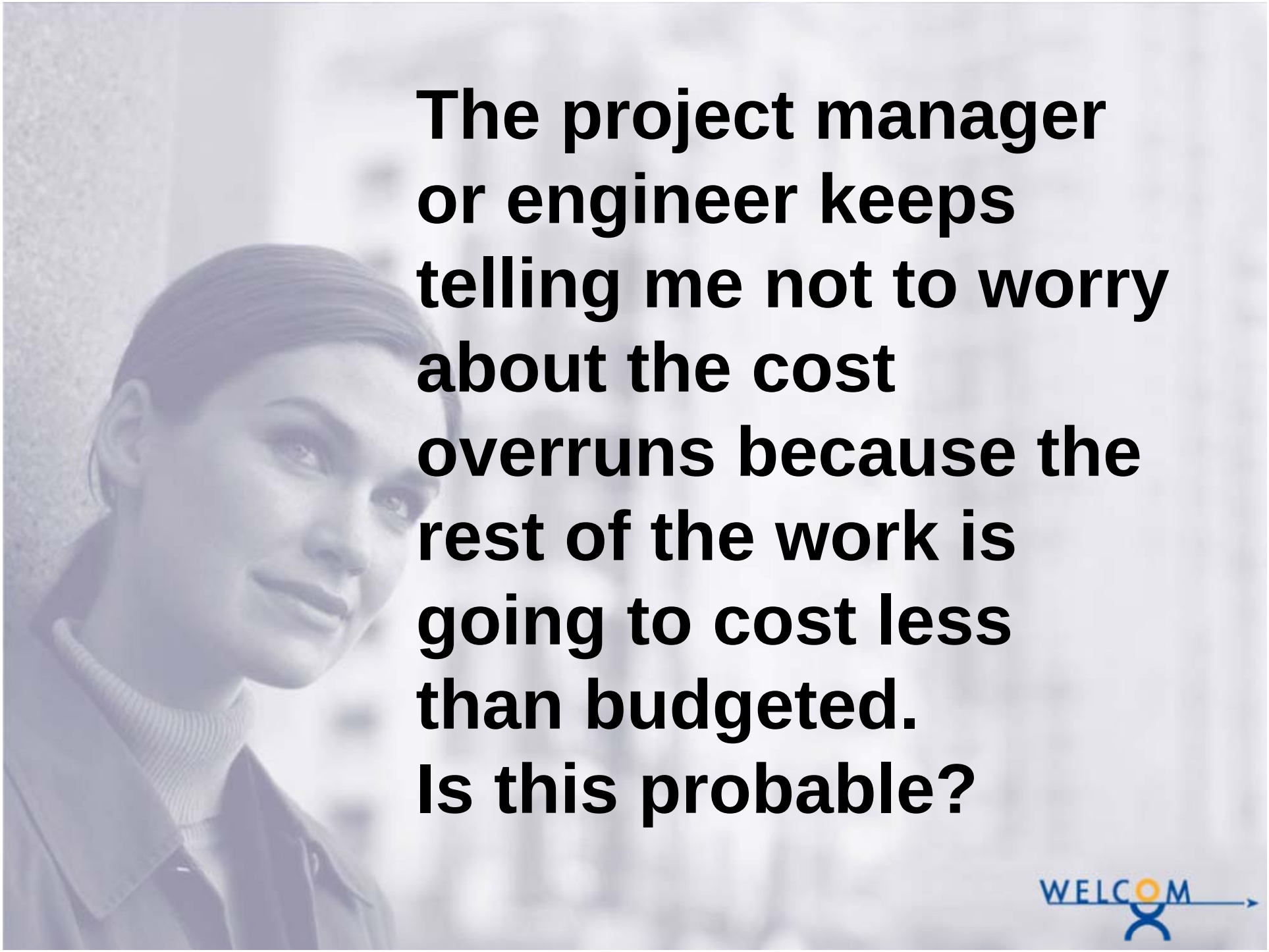
MULTIPLE FORECASTS

- A set of forecasts:
  - optimistic
  - pessimistic
  - most likely
- Manual forecasts entered by the project manager
- Statistical forecasts used to increase confidence in the manual forecasts
- Reporting (customer) forecast

MULTIPLE FORECASTS



- Statistical
- Customer
- Project Manager
- Remaining budget



The project manager or engineer keeps telling me not to worry about the cost overruns because the rest of the work is going to cost less than budgeted.
Is this probable?

COST OVERRUNS

Despite the widely known fact that the recoveries from cost overruns on defense contracts are extremely rare, analysis of 64 completed contracts showed that the final cost overruns estimated by the contractor were less than the current cost overruns.

Christensen, David S., Ph.D., "Cost Overrun Optimism – Fact or Fiction?" Acquisition Review Quarterly.

COST OVERRUNS

According to some authors, determining the most accurate estimate has never been the objective of the contractor. Instead, the objective has been to protect the project and the careers of its managers, even if that means understating the projected completion cost.

Fox, J. Roldan. "Arming America: How the US Buys Weapons" Boston, Mass: Harvard University.

Mayer, Kenneth R. "The Political Economy of Defense Contracting." New Haven, Conn: Yale University.

TCPI

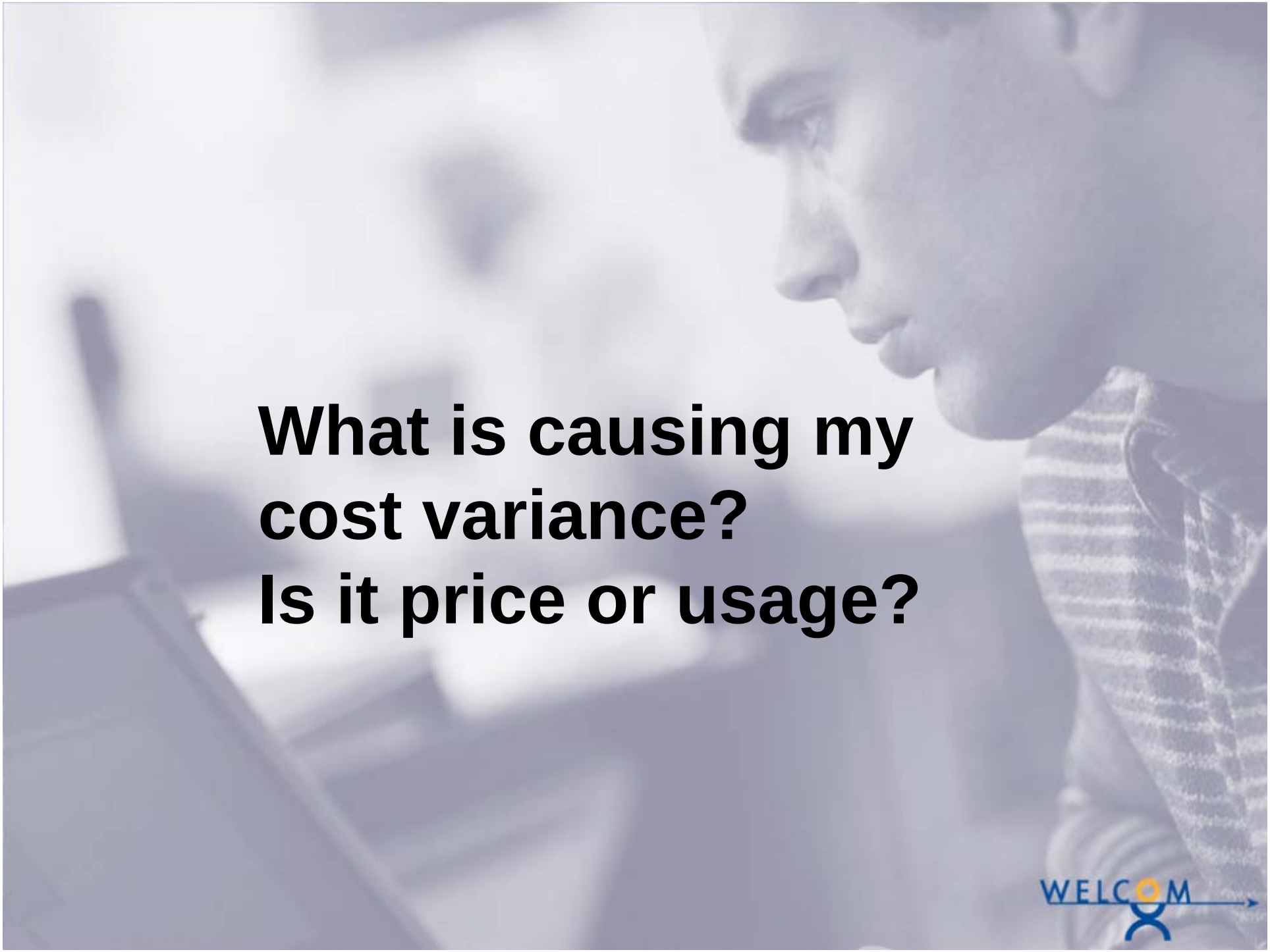
- The To Complete Performance Index (TCPI) is an index that rates the probability of a forecast.

$$TCPI = \frac{PV - EV}{EAC - AC}$$

This is sometimes called the CPI to EAC index.

TCPI

- The forecast is **probable** if the **TCPI equals the CPI** cumulative-to-date.
- A **TCPI of less than the CPI** shows an increase in performance making the forecast statistically **not probable**.
- A **TCPI greater than the CPI** shows a decrease in performance for the remaining work.


What is causing my cost variance?
Is it price or usage?

CAN YOU ANSWER?

Are my resources more expensive than originally planned?

Is it taking more resources to do the work than originally planned?

PRICE VARIANCE

Price Variance =
(Earned Price – Actual Price) x
Actual Quantity

Price variances are compensated for in a forecast by changing the labor rate.

USAGE VARIANCE

Usage Variance = (Earned Quantity – Actual Quantity) x Earned Price

A usage variance is compensated for in a forecast by using statistical forecast methods based on past performance.

QUESTIONS?